Antecedents of the Adoption of the New Mobile Payment System in Sudan

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Abstract
The technological improvement in the area of telecommunication and the growing use of smartphones around the world has facilitated the purchase and payment transaction via mobile phone. This emerging mode of payment provides flexibility and convenience to consumers without trouble. This paper proposes a model consisting of several factors to investigate the factors that have influenced the adoption of mobile payment in Sudan. An online questionnaire was utilized to collect data from 453 valid samples, which were obtained from M-Gorooshi, Hassa, and mobile Cash customers in Sudan. SPSS was used for analyzing the collected data, the statistical analysis showed that technical culturation is the most significant behavioral intention factor, followed by facilitating conditions. Additionally, the multi-group analyses' outcomes indicate that the relative advantage of the behavioral intention depends on gender, age, and education.
Keywords: Mobile payment, Sudan, UTAUT, Behavioral intention, Actual usage

1. Introduction

The massive growth of information technology and communication changes the community lifestyle in a different corner of the world. One of the leading areas where this is manifested is the way business is conducted. Electronic payment is transferring value electronically, based on secure information and communication technology (ICT) infrastructure, efficient, legal, and accessibility of the public and business [1].

Mobile Technology is a prominent ICT financial tool and is widely used in many developing countries [2]. Smartphones make finance fast, cheap, and secure for millions of individuals worldwide [3]. Mobile banking is the first mobile application that enables unbanked users to manage their accounts. Moreover, users can access their accounts regardless of time and place [4], [5]. Mobile finance can enhance the development of socio-economic in developing countries [6].

Mobile payment has witnessed steady growth in some developing countries in Africa, such as Kenya, Tanzania, Uganda, and Rwanda, and in Asia, such as Bangladesh [7]. However, over the past few years, Sudan has witnessed some critical innovation payment systems such as M-Banking in 2009, M-

Gorooshi, Hassa, and mobile Cash [8], [9]. Adoptingthese new payment methods provides convenience and security to the consumers, it also also plays a significant role in promoting economic growth, reducing cash and check handling for traders and expanding the amount of customers who are guaranteed to pay. Furthermore, by reducing the number of unreported transactions in the gray economy, governments are better able to collect additional tax revenue [3], [10]. Thus, with regard to the availability and accessibility of such mobile payment systems in Sudan, one question arises, what prevents customers from using these payment systems? The contrast between the growing market of mobile payment, with low adoption and stickiness among the users in Sudan, raises one interesting question: Which antecedents impact the use of m-payment systems in Sudan?

To examine the antecedent that impact the use of m-payment services in Sudan, we consider users as consumers (buyers) of m-payment services and services providers as a seller. The service provider should develop the mobile payment market in Sudan. Market development indicates the efficient changes between the buyers and sellers, which will bring consumers (buyers) to the mainstream economy by generating economic activity and development (Prahalad and Hammond 2002).

This research aims to study the factors that impact the use of m-payment and the growth of m-payment services in Sudan. This study's objectives are the following (a) to develop a model of the

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factors of mobile payment acceptance constructed on Unified theory of acceptance and use of technology (UTAUT) (b) identify the relative advantages that can affect the user's behavioral intention to use mobile payment in Sudan (c) to investigate the moderating effect of gender, age, and education in the use of mobile payment. Although UTAUT is a prominent model in the field of technology adoption and utilization, no previous research investigated UTAUT theory in the context of Sudan. The present research aimed to fill the gap by investigating the ability of the model to explain mobile payment expected user behavior. To achieve this aim, the study focused on the factors that affect mobile payment adoption in Sudan. This research provides a significant finding that can inform service providers in developing and implementing mobile payments in developing countries, especially Sudan.

This paper was divided into sections; the literature review of mobile payment, the proposed model and the suggested relationship among the factors, the research methods, findings and discussion, and research and implications.

2. Proposed model and development of hypotheses

According to [12], financial management could be developed by improving the financial system. For example, mobile payment can enhance economic activities and bring a positive return to the stakeholders, including unbanked entities [13], [14]; this can be seen obviously in developing countries. This financial information enables decision-makers to set realistic plans [15].

The construct factors of which the models and theories of technology adoption that has been previously included are not conclusively, others failed to considered new elements that have to be integrated [16], [17]. Most of the technology adoption previous studies use the theory of

technology acceptance model [18]. The technology acceptance model's construct in its current factors is general and insufficient to elucidate technology adoption [19]. Technology acceptance model limitations were discussed and reported that the high number of UTAUT independent factors makes the evaluating process more complicated and insufficient to fully understand the whole picture of technology adoption [20]. [21] confirm that UTAUT can be adjusted according to the technology in use. The study conducted by analyzing mobile phone technology and mobile government service in Saudi Arabia found that the UTAUT2 can be suitable to be modified and extended by considering emerging construct that applies to the context of Arab customers' adoption [22].

The UTAUT and Theory of Reasoned action (TRA) focus on technological perspective, which is based on perception and attitudes; they have been commonly used as a ground for information technology research at the individual level [23].

The objective of this research is to investigate the m-payment adoption factors at both individual and organizational levels. After studying the literature review in the field, we found that the UTAUT theory is suitable for studying factors that impact the adoption of new technology at a different stage. Further, it also enables us to evaluate the importance of various factors which affect the new technology adoption [24]–[26].

There are several factors that have been examined at adopting new technology in prior research. It is impossible to identify in the technological innovation literature. Moreover, the researchers argued that it is challenging to create a unifying theory of innovation due to the fundamental difference between innovation types [27]. Thus, this study well-chosen the factors that are more related and applicable to adopting mobile payment adoption in Sudan. Each of these factors is clearly discussed below.
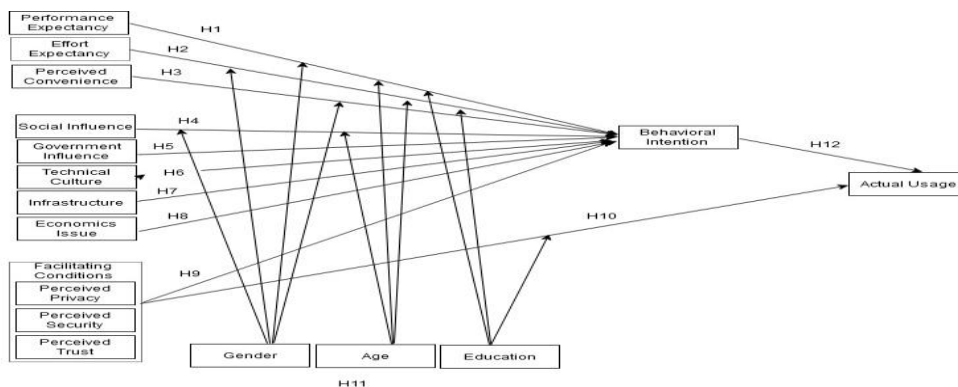

Figure 1. **The research model**

2.1. Performance expectancy, an effort expected, is moderated by gender, age, and education

How people accept and adopt, the new technology is significant question that needs to be answered. One factor is *perceived usefulness which is defined as "the degree to which a person believes that using a particular system would enhance his/her job performance* [28]. According to UTAUT, performance expectancy is defined as *"the degree to which using a technology will provide the benefit to the customer in performing certain activities"* [29]. Previous studies confirmed that perceived usefulness is important factor for behavioral intention [16], [28]. The term (Relative advantage) is more detailed and perceptive to the users [30]. Thus in the current study, perceived usefulness representing performance expectancy in the UTAUT 2 [29].

Perceived ease of use (PEOU) is defined *as the degree to which a person believes that using m-payment would be free of effort* [31]. Perceived ease of use represents the degree to which an innovation is perceived no to be challenging to understand, to learn, or operate [32]. Perceived ease of use means effort expectancy. Thus, from the above discussion, we suggest the following hypotheses.

H1: performance expectancy "usefulness" positively and strongly influence behavioral intention to use mobile payment in Sudan

H2: effort expecatancy "ease of use" positively and strongly influence behavioral intention to use mobile payment in Sudan

2.2. Perceived Convenience is moderated by gender

The issue of service convenience is crucial to the economics services [33]. Profoundly, people believe that technology is useful when it is based on making people's lives easier and reducing the difficulty of a common task [34]. Previously the construct of convenience was investigated in marketing and consumer behavior by research such as [33], [35]. Convenience has been found as one of the crucial antecedents in m-commerce's success [36]. Convenience is related to the factors generating time and place utility for customers [37]. Convenience is a combination of time and place utility and principal characteristics of mobile payment [38]. We integrated convenience construct to our model due to its importance, especially in Sudan, which 90% of its geographical location is a rural area, which suffers the lack of banks, higher risk, lack of road, transportation infrastructure and cost [39]. Thus we propose the following hypotheses.

H3: Convenience positively influence behavioral intention to use mobile payment in Sudan

2.3. Social influence is moderated by gender and age

Social influence is defined as "the extent to which customers perceive that important others (e.g., family and friends) believed that they should use a particular technology" [29]. Social influence is a construct adopted from theory of planned behavior, which means that individuals are likely to accept a specific system if the people around them show a positive attitude [40]. In the study that was conducted by [41], results found out that social influence has a significant relationship with mobile banking. On the other hand, some researchers conducted in Africa, Korea, and Jordan show no significant relationship between social influence and mobile bank adoption [42]–[44]. Hence we hypothesized the following

H4: Social influence positively influences behavioral intention of customers to use mobile payment in Sudan.

2.4. Government influence

Government influence refers to the support that service providers get from the authorities to encourage the diffusion of IT/IS innovation in its framework [45]. Government influence can also be referred to as governmental assistance [45], [46]. The government strongly affects different kinds of firms. Government regulation can determine the entry barriers for companies, investment. Further, it also provides subsidies that motivate firms to adopt information technology or develop new techniques [47]. However, the government is enthusiastic to see technological innovation adopted by small businesses; the government is globally aware of IT's importance to the nation's development, especially in the economics sector [13], [47].

The advent of innovative technology raises the need for the formulation of new regulation and policies framework. Direct R&D funding, as well as agency-level research policy, are examples of these policies, and research and development tax credits [47]. Without government law and procedures, the abuse and discouragement of adopting new technology innovation in an organization will be high; many studies confirmed that government, through regulation, can encourage technological innovation adoption and use [47], [48]. Moreover, through building infrastructure and implementing

policies and regulations, the government can create a suitable technological environment, which will influence the decision to adopt the new technology [47]. A government rule is essential for enhancing the adoption of the latest technologies acceptance by the users. Based on the above discussion we proposed the following proposition:

H5: Government influence significantly influence the behavioral intention of using mobile payment in Sudan

2.5. Technological culture

Since Sudan is an Afro-Arab country with Arab dominated culture, due to the Sudan location and diversity, we integrated technical culture into our proposed model. Technical culturation is defined as "*influential experiences that individuals have had with technologically advanced cultures*" [49]. Informal technical culturation was found to be significant in the study of [49]. In the context of Sudanese people, technical culturation can take another form. The mobile payment market needs to be open in Arab and African countries, and new technology needs to be introduced to these countries at a different and low cost. The construct of technical culturation was adopted from [49], This includes the amount of time spent traveling for work, for pleasure, for contact with family members who live abroad, and for development. The model items can be modified to fit the current study. Thus we suggest the following hypothesis.

H6: Technical culturation significantly influence behavioral intention of mobile payment in Sudan

2.6. Infrastructure dimension

International organizations like the World Bank, International Monetary Fund, International Telecommunication Union, and the United Nations have argued that investment in ITC infrastructures is a prerequisite for advancing developing countries' situation. It has also prompted the governments of these developing countries to develop technology policies and promote the development of telecommunications infrastructure [50]. Some scholars argued that ICT could make a crucial contribution to the social development in African countries; moreover, ICT will bring more "chances to the global digital economy" to remote parts of African communities [51]. It has been hypothesized that the telecommunication infrastructure lowers the cost of acquiring information and the variable cost of participating in markets [52]. Governments worldwide are trying to develop public infrastructure that could guarantee secure transactions between organizations and

individuals [53]. Well-functioning payment infrastructure has been described as an important tool that can enhance the financial system's efficiency and financial market; facilitating economic interaction and trade and enhancing user's confidence [54]. The turn of ICT in developing countries' economics is undeniable; the basics of using ICT need very stable internet infrastructure such as internet coverage. Sudan is facing political instability. For example, the conflict in Darfur region, which caused the country to face international pressure, the telecommunication operators have difficulties expanding the internet coverage to the conflict areas [55]. Due to the importance of ICT infrastructure and based on the above discussion, we proposed the following hypotheses:

H7: Infrastructure positively influence the behavioral intention of mobile payment in Sudan

2.7. Economics Issues

We included economic issues into the UTAUT model. Economic issues is defined as a degree to which an people consider that using mobile banking will be cost effective [40], [56]. In the study that conducted by [57] result found that the effect of economic issues differ based on culture and economic factors prevalent in a context. Economic issues found to be significantly affect the adoption of mobile banking services [58]; when users consider Technology expensive, it invariable influence its adoption. Some others research found that there is no relationship between economic issues and mobile banking adoption [57]. However, in other study found that there is no significant relationship between economic issues and mobile banking adoption [59]. In study that conducted by [60] found that economic issues has significant influence on mobile banking adoption. Thus we suggest the following.

H8: Economics issue significantly influence behavioral intention of mobile payment in Sudan

2.8. Facilitating condition is moderated by education

Facilitating conditions was defined as a "consumers perceptions of the resources and support available to perform a behavior" [29]. acilitating conditions are infrastructures that support the use and utilization of a technology [21] that lead to the technology adoption. Moreover facilitating condition makes the technology adoption easier for adoption and sustainable usage. Trust, security and privacy are factors that integrated in facilitating conditions [61]. These conditions determined those customers'

expectations from the services providers and increase their perceived certainty concerning the providers expected behavior. Previous studies confirmed that facilitating conditions significantly influence behavior intention and actual usage of the technology [16], [29], [61]. Based on the above discussion we proposed the following hypotheses.

H9: Facilitating conditions positively influence behavioral intention of mobile payment in Sudan.

H10: Facilitating conditions significantly influence the actual usage of mobile payment in Sudan.

2.9. Moderating variables

The researchers used moderating variables to investigate mobile service adoption behavior. Previous studies show that gender, age, and education might affect adopting new technology and services due to their effect on the other construct [21], [62]. Social cognitive theories proved that male and female behave differently in different situation. Mainly, males are result-oriented concentrate on usefulness and actual performance, while females are process-oriented and focus on security and privacy when engaging in new activities. Male and females behave differently in the context of the utility of information technologies [63]–[65]. Moreover, the construct of effort expectancy (ease of use) is more prominent for females and older adopters [66].

In addition, females are more sensitive to social structure opinions. When it comes to deciding whether or not to adopt new technology or services, females are more influenced by social influence antecedents [67]. Mobile payment adoption and usage significant among young users; therefore, treating them as a homogenous group is not suitable. Likely, because affiliation needs increase with age [68], older adopters are more likely to be influenced by social influence. A study conducted about e-commerce found out that younger and educated people are more positive adoption of e-commerce in countries like India, Argentina, Malaysia, and China. Further, adopting e-commerce is higher and faster than in countries like Nigeria, Bolivia, Bangladesh, and Sudan. People are not skillful at using new technology, and that training and support are not provided. Education was also found strong control variable affecting the adoption of Technology in developing countries like Sudan [26]. Education increased users' adoption of the Technology and decreased social influence on behavior [69]. Thus, users need to be educated about mobile payment service's potentials and the convenience this service may bring to the users

when they adopted it in their daily life [61]. Based on the review above, we hypothesized that:

H11: gender, age, and education moderate the relationship among (performance expectancy, effort expectancy, perceived convenience, social influence, and facilitating condition); the proposed model constructs.

2.10. Behavioral intention

Davis and Cosenza [70] defined behavioral intention (BI) as the degree to which a user's motivation intends to adopt and use a new mobile payment system. [31] stated that the intention to use a platform could illustrate a significant portion of the actual user's use of the system, and that these are our goals, aspirations, and anticipated responses to the situation object. Yassin and Zayed (2012) defined intention as "*an indication of a person's willingness to perform a certain behavior, and it is considered a direct precedent to the behavior.*" [21], predicted that behavioral intention would have a positive effect on technology use. Thus the study proposed the following hypotheses.

H12: Behavior intention (BI) positively and significantly influence the actual usage of m-payment

3. Data collection

The current study's data was gathered from consumers of the most popular mobile payment platforms, i.e., M-Gorooshi, Hassa, and mobile Cash [8], [9] in Sudan. An online questionnaire was designed to gather the data. In this research, we mainly targeted those who have specific experience in using mobile payment services in urban area of Sudan (Khartoum and Madani). A total of 467 surveys were distributed and collected online at random among different Sudan students and employees. Researchers have received 453, which were found to be completed and valid for the statistical analysis with a respondent's rate representing (48.8%) 221 females and (51.2%) 232 males. The sample size was deemed significant enough to generate accurate results for the entire study population. The participants in this research were between 18-45 years of age. The results are shown in Table (1).

The instrument of this study was adopted from the previous mobile payment studies. All the constructs were measured with three to four items, and a seven-point Likert scale was used. The elements of the study were modified to fit the current research in the mobile payment context in Sudan, which took around two months. For validity, a construct pilot measurement was used. Fifty respondents who

have experienced using mobile payment platforms were invited to complete the initial questionnaire. Based on the feedback, we adjusted some items by deleting one item from Perceived Convenience and deleting one from Social Influence to fit the current study. The employed questionnaire is as shown in the table (2).

Table 1. **Demographic Data, N= 453**

Items	Category	Participants	%	Female (N=221) 48.8%	%	Male (N=232) 51.2%	%
Age	Less than 20	41	9.1	16	7.2	25	10.8
	20-30	72	15.9	30	13.6	42	18.1
	31-40	195	43	76	34.4	119	51.3
	41 -50	102	22.5	67	30.3	35	15.1
	51 and above	43	9.5	32	14.5	11	4.7
Occupation	Students	82	18.1	30	13.6	52	22.4
	Employees	249	55.0	99	44.8	150	64.7
	Other	122	26.9	92	41.6	30	12.9
Monthly Rate	1000-10000	66	14.6	30	13.6	36	15.5
	10001-20000	134	29.6	40	18.1	94	40.5
	20001-30000	99	21.9	67	30.3	32	13.8
	30001-40000	87	19.2	47	21.3	40	17.2
	40001 and above	67	14.8	37	16.7	30	13
Education	high school	25	5.5	10	4.5	15	6.5
	bachelor	109	24.1	53	23.9	56	24.1
	master	172	38.0	74	33.5	98	42.2
	PhD	64	14.1	34	15.4	30	13
	Others	83	18.3	50	22.6	33	14.2

3.1. Results of Measurement Model

For testing the proposed theoretical model, the study uses structural equation modeling. Additionally, the partial least squares (PLS) [73] method was selected since it is recognized as an effective statistical analysis method for assessment and analyzing psychometric properties (reliability and validity) [73].

The assessment includes tests of construct reliability and validity. In this study, the Alpha coefficient [74] was used for the internal consistency of the collected data, and the result of the Alpha coefficient is shown in Table 2. The entire alpha is more significant than 0.70, which means that the collected data meet the requirement [74]. We also test the composite reliabilities (CR), which were higher than the 0.70 thresholds as shown in Table 3, thereby supporting the model's good reliability and internal consistency [75]. Each construct item loading was calculated to ensure convergent validity, and the average variance extracted (AVE) was also calculated [74]. The results showed that all item loadings are above 0.40, and the AVEs are above 0.50, as shown in Table 3, and

Table 4 provides the results of the discriminant validity analysis.

Furthermore, we used confirmatory factor analysis to determine if the model fit index is good. In SEM, many fit indices, like goodness-of-fit, exist to appraise the entire model, such as X2=453.597, DF=245, X2/ DF = 1.851, CFI=.904, GFI=.913, AGFI=.899, TLI, NFI=.921, and RMSEA=.081[75].All fit indexes came significantly and acceptable according to the critical statistics [74][75], and can also help in testing null hypotheses. In this research, we evaluate the fitness of the model using the indexes.

3.2. Structural Equation Modeling Analysis and Results

The structural model is examined by evaluating path relationships and estimating the values of endogenous latent variables. Moreover, the 95% Confidence

Interval method is used to assess the path relationships' significance since it is beneficial to use the Z-Value or obtain valid standard errors. Figure 2 represents all the analysis results.

Table 2. **The study measurement**

Items	Performance expectancy	
Item1	Using mobile payment will help me to accomplish financial transaction very fast	
Item2	Mobile payment can be useful in my daily life	[29]
Item3	My productivity will rise as a result of using mobile payment	
Item4	I'll save time by using mobile payments	
	Effort expectancy	
Item1	It is simple for me to learn how to use mobile payment	
Item2	Using mobile payment will be easy	[29]
Item3	It is simple for me to be proficient in the use of mobile payment	
	Social Influence	
Item1	People who matter to me believe I should use mobile payment	
Item2	Individuals who have an impact on my behavior believe I should use mobile payment	[29]
Item3	People whose views I respect would like me to use mobile payment	
	Government Influence	
Item1	The government encourages the development of mobile payment	
Item2	I believe government can solve disputes when caused	[29]
Item3	State government agencies can be relied on to carry out mobile payment transactions in a reliable manner	
	Perceived Convenience	
Item1	Mobile payment is convenient because I always have my phone with me	
Item2	Mobile payment is convenient because I can use it whenever I want	[29]
Item3	Mobile payment is convenient because I can use it in any situation	
Item4	Mobile payment is convenient because mobile payment service is not complex	
	Facilitating Conditions	
Item1	I have the resources necessary to use mobile payment	
Item2	When I am having difficulties with mobile payment, I can seek assistance from others	[29]
Item3	I have the required resources to use a mobile payment application	
Item4	I have the necessary knowledge to use mobile payment.	
	Technical Culture	
Item1	I find that due to the extent of travel for the pleasure it is essential to use Technology	
Item2	The current environment support the use of Technology	[49]
Item3	I find that training provided by foreign companies in my country helps use Technology.	
	Infrastructure	
Item1	The Internet makes me feel comfortable at using mobile payment	
Item2	I am confident that legal and technological structures adequately protect me from Internet problems	[71]
Item3	In general, the Internet is now a stable and secure environment in which to conduct business with state government agencies	
Item4	The stability of the Internet encourages me to use m-payment	
	Economics issue	
Item1	Mobile payment is an affordable way of payment	
Item2	Mobile payment is cost-effective	[40]
Item3	The cost charged on mobile payment is ideal	
	Behavioural intention	
Item1	I intend to use mobile payment in the future	
Item2	I will always use mobile payment in my daily life	[29]
Item3	I plan to continue to use mobile payment frequently	[16]
Item4	I would use mobile payment	
	Actual usage	
Item1	Mobile payment is an affordable way of payment	
Item2	Mobile payment is cost-effective	[72]
Item3	The cost charged on mobile payment is ideal	

Table 3. **Psychometric Properties Analysis (Reliability and Validity)**

Factors	Items	Loading	Alpha (α)	CR	AVE
Performance expectancy	Item1	.989	0.843	0.801	0.643
	Item3	.989			
	Item2	.987			
	Item4	.982			
	Item6	.939			
Effort expectancy	Item5	.938	0.802	0.731	0.595
	Item7	.662			
Social Influence	Item10	.900	0.723	0.791	0.559
	Item9	.882			
	Item8	.511			
Government Influence	Item12	.921	0.708	0.734	0.545
	Item11	.915			
	Item13	.468			
Perceived Convenience	Item16	.748	0.740	0.799	0.637
	Item15	.648			
	Item14	.579			
Facilitating Conditions	Item17	.579	0.713	0.721	0.608
	Item20	.635			
	Item19	.586			
	Item18	.559			
	Item21	.533			
Technical Culture	Item28	.786	0.845	0.833	0.710
	Item26	.705			
	Item27	.506			
Infrastructure	Item22	.782	0725	0.775	0.589
	Item25	.595			
	Item24	.566			
	Item23	.565			
Economics issue	Item28	.786	0.811	0.789	0.615
	Item26	.705			
	Item27	.506			
Behavioural intention	Item30	.706	0.787	0.824	0.653
	Item29	.516			
	Item32	.410			
	Item31	.409			
Actual usage	Item36	.706	0.794	0.803	0.597
	Item37	.471			
	Item38	.432			

Table 4. **Discriminant Validity Analysis**

| Variable	1	2	3	4	5	6	7	8	9	10	11
PE	_	.106	.148	.088	.038	.025	.048	.029	.016	.001	.105
EE	.326**	_	.033	.031	.016	.019	.032	.023	.016	.036	.001
SI	.122*	.183*	_	.015	.027	.019	.031	.024	.138	.026	.014
GI	.137*	.177*	.124*	_	.016	.033	.015	.025	.021	.006	.069
PC	.196*	.127*	.163*	.128*	_	.023	.022	.022	.044	.021	.016
FC	.159*	.140*	.139*	.183*	.154*	_	.022	.017	.038	.030	.026
TC	.220**	.180*	.176*	.124*	.151*	.148*	_	.032	.027	.017	.015
INF	.170*	.153*	.155*	.157*	.149*	.131*	.178*	_	.023	.014	.059
EI	.125*	.127*	.371**	.146*	.210**	.196*	.165*	.151*	_	.013	.064
BI	.027	.190*	.160*	.075	.146*	.172*	.131*	.120*	.113*	_	.014
AU	.325**	.028	.118*	.264**	.127*	.161*	.122*	.242**	.253**	.119*	_
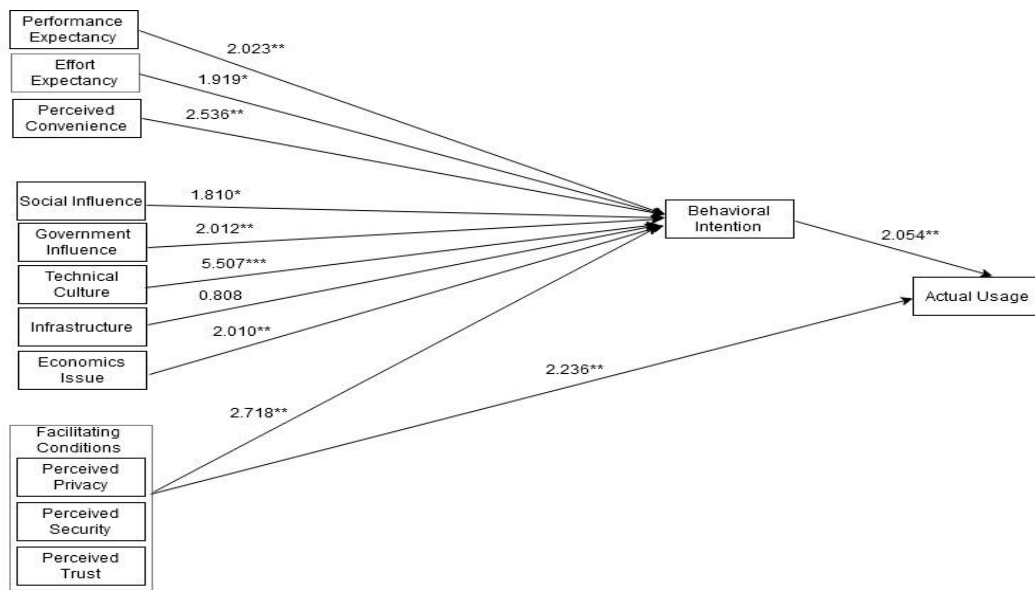
Figure 2: Results of the research model

Figure 2 exhibits that H1, H2, H3, H4, H5, H6, H8, H9 are positively associated with behavioural intention to use mobile payment, and they supported the hypotheses respectively, except H7, which found unsupported assumptions. Moreover, H10 completely and directly associated with the actual usage of mobile payment.

3.3. Moderating effect

This research also studies the mediating effect of mobile payment adoption in the relationship among the independent variables (performance expectancy, effort expectancy, perceived convenience, social influence, and facilitating condition) and the dependent variable (actual usage) using Smart-PLS [76]. The study applied the Sobel test, which is the primary statistical tool in investigating the mediating effect. The results are shown (5).

Table 5. **Evaluation of gender**

Relationship Variables	β	B	Path coefficients		CI		
			Males N=232	Females N=221	t-spooled	Lower	upper
PE→BI	0.486	10.582	0.686**	0.631**	14.172	9.110	12.054
EE→BI	0.430	9.954	0.490**	0.479**	12.155	8.340	11.568
SI→BI	0.380	11.272	0.568**	0.551**	11.397	9.323	13.222
PC→BI	0.519	10.203	0.483**	0.538**	15.684	8.921	11.485

Moreover, the bootstrapping analysis results show that there is an indirect effect of performance expectancy on behavioural intention due to behavioural intention (β= 0.486), with a 95% confidence interval excluding zero (BI=9.110 to 12.054). Additionally effort expectancy on behavioral intention (β = 0.430, BI 8.340 to 11.568), social influence and behavioral intention (β =0.380, 9.323 to 13.222) and perceived convenience and behavioral intention (β = 0.519, 8.921 to 11.485). Our results show that the four independent variables' immediate impacts on behavioural intention remain significant when including behavioural intention as a mediator, and the result is shown in table (5).

The multigroup PLS test outcome showed that

the path coefficient between performance expectancy and behavioural intention is significantly higher for males than for female users (path coefficient of male=0.686** and female=0.631**, T-test=14.172), which supported the hypotheses. Effort expectancy and behavioural intention are significantly higher for male users than females (path coefficient of male=0.490** and female=0.479**, T-test=12.155), which supported our hypotheses. Moreover, social influence and behavioural intention are significantly higher for males than females users (path coefficient of male=0.568**, and female=0.551**, T-test=11.397), and perceived convenience is highly significant for females than males users (path coefficient of male=0.483** and female=0.538**, T-test=15.684)

which supported the hypotheses.

Table 6. **Evaluation of age and education**

Age	Estimate	Z-Value	CI Lower	upper	Education	Estimate	Z-Value	CI Lower	upper
PE→Age→BI	4.753	5.039[**]	1.007	5.913	PE→Edu→BI	6.014	6.269[***]	2.035	7.027
EE→Age→BI	7.957	7.514[***]	2.911	7.825	EE→Edu→BI	2.002	2.506[**]	0.041	0.987
SI→Age→BI	3.915	3.549[**]	1.014	3.911	FC→Edu→AU	5.064	5.710[**]	2.018	5.910

Note: [***]p≤ 0.001; [**]p≤0.01

The results of age and education analysis have shown that in table 4, the indirect impact of performance expectancy on behavioural intention due to the age mediator (Estimate=4.753, Z-Value =5.039**) with a 95% confidence interval (CI=1.007 to 5.913). Additionally effort expectancy on behavioral intention is mediated by age (Estimate=7.957, Z-Value=7.514***) with a 95% confidence interval (CI=2.911 to 7.825), social influence on behavioral intention is mediated by age (CI=3.915, Z-Value= 3.549**) with a 95% confidence interval (CI=1.014 to 3.911). While education analysis has shown that the indirect effect of performance expectancy on behavioural intention due to education mediator (Estimate=6.014, Z-Value =6.269) and 95% confidence interval (CI=2.035 to 7.027). Moreover, effort expectancy on behavioural intention is indirectly affected due to education mediator (Estimate=2.002, Z-Value =2.506**) and (CI=0.041 to 0.987), facilitating condition on actual usage is affected by the indirect effect of education mediator (Estimate=5.064, Z-Value=5.710**) with a 95% confidence interval (CI=2.018 to 5.910). Our results show that the immediate impacts of independent variables on behavioural intention remain significant when including the mediator.

4. Discussion

This study investigates the factors influencing the adoption of m-payment in Sudan. The current study's outcome showed that performance expectancy, effort expectancy, perceived convenience, social influence, government influence, technical culturation, and economic issues positively and significantly influence behavioral intention. Further, facilitating conditions directly affect behavioral intention and actual usage of mobile payment. Besides, behavioral intention to use is significantly correlated with the actual usage of mobile payment.

Performance expectancy and effort expectancy are essential factors that affect adopting the new technology, as confirmed in the previous studies [31], [77]. If the Sudanese are not fully aware of the benefit of using mobile payment, they will not tend to use it. Thus it would be beneficial to increase the awareness of using mobile payment among Sudanese especially educated males [78].

Perceived convenience has a more significant influence on female's behavioral intentions. this may indicate that females are more aware of the convenience of using mobile payment also; it may be due to the gender gap, and mobile payment allowed females to overcome the culture barriers.

This study's empirical evidence found that social influence positively related with behavioral intention to use m-payment this finding consent with ['41]. The interesting finding is that social impact is higher for males; they are more affected by the WOM; this may be due to consuming culture.

Government influence was found to have a significant relationship with behavioral intention. Government rule is essential for enhancing the adoption of the new technologies acceptance by the users. Thus government roles should not be absent when constructing a mobile payment system. People may use the service when they feel that they are protected.

Technical culturation have found to have the strongest predictor of behavioral intention to use m-payment system in our proposed model this result consent with the previous research finding of [16]. The outcome of this shows that the cultural factors related to technology play an important role in adopting mobile payment. Additionally, infrastructure has been found negatively associated with behavioral intention. This may affect adopting the new payment system; Sudan can achieve more advancement in mobile payment adoption by improving the infrastructure.

Although the economics issue significantly correlated to behavioral intention but is not the most significant factor influencing behavioral intention, this result consent [60]. When users consider technology expensive, it invariable influence its adoption. Some other research found that economic issues negatively correlated with mobile banking adoption [57]. However, the finding of this research consent with [60] and disagree with

[59].

Facilitating conditions significantly affect behavioral intention and actual usage. Facilitating condition on actual usage is affected by the indirect effect of education mediator. Facilitating conditions are infrastructures that support the use and utilization of a technology that leads to the technology adoption. Moreover, facilitating conditions makes technology adoption easier for adoption and sustainable usage.

5. Theoretical and Applied Implications

The study makes some contributions. First, the study investigated many significant antecedents that enhance our understanding of the behavioural intention and actual use of mobile payment in Sudan. The second fundamental contribution of this research is we extended the UATUA. Most of the previous studies regard the relative advantage as a general construct while ignoring its particular attributes in different research contexts. Comparative advantage includes (performance expectancy, effort expectancy, and perceived convenience). The study investigates their effect on the customer's behavioural intention and the actual usage of the mobile payment platform. In particular, the research finds that users' understanding of performance, effort expectancy, and perceived convenience are significant factors that boost behavioural intention toward using mobile payment platforms, affecting customer's actual usage.

Moreover, social influence, government influence, technical culturation (the most important predictor of customer's behavioural intention), and economic issues influence behavioral intention and actual usage of mobile payment significantly. Surprisingly, infrastructure is an insignificant factor; to behavioural intention. Additionally, facilitating condition, directly and indirectly, affects the behavioural purpose and actual usage of mobile payment platforms in Sudan. Therefore, the current research finding can increase our understanding of mobile payment use in Sudan from the UATUA perspective. Third, the study finds that gender, age, and education are significant antecedents and investigates their moderating effects on the behavioural intention process.

Although some previous studies have investigated the role of gender, age, and education in the adoption of m-payment, still little attention has been paid to gender, age, and education in the context of Sudan. The multi-group analyses' finding shows that performance expectancy, effort

expectancy, perceived convenience, and social influence on behavioural intention are conditioned upon gender. The study mainly finds that performance expectancy, effort expectancy, and social influence have a more significant effect on males' behavioral intention. This result indicates that the wide gender gap in mobile payment use among Sudanese males and females comes in line with [16]. Perceived convenience has been found to have a more significant effect on a behavioral intention for females. Our study outcomes are in line with previous studies [21], [29], which found significant differences between males and females regarding factors that have the most decisive influence on technology adoption. Gender, within the context of Arab countries, was expected to be a significant mediator of this study factors.

Previously perceived usefulness has been opined by many scholars [31], [77] as a crucial factor that affects people's to adopt the new technology. If Sudanese females are not fully aware of mobile payment benefits, they will not use them; thus, it would be helpful to rise the awareness of mobile payment benefits, particularly among females.

The current study revealed that females focus more on perceived convenience when it comes to behavioural intention to use mobile payment. This because women characteristics prefer to have convenience products or services during online transactions. Perceived convenience is one of the outstanding antecedents that effect behavioural intention and mobile payment's actual use. Thus Sudanese female mobile users are strongly and significantly affected by convenience. Males are more affected by performance expectancy, effort expectancy, and social influence. This indicates that the vast gender difference among Sudanese males and females [67]. Males use techniques to achieve particular benefits; these advantages created more positive behavioural intention for males to use mobile payment since males have more confidence and self-assessment. Gender differences are more apparent in Arab countries due to the nature of Arab culture [79]. Moreover, the study found that effort expectancy is positively moderated by age, followed by performance expectancy and social influence on behavioural intention. While performance expectancy is highly moderated by education, followed by facilitating condition and effort expectancy.

The research provides many practical guidelines for operating and developing a mobile payment platform. The service provider needs to realize the importance of mobile payment characters and

develop m-payment according to users' needs and wants. Further, they should also take advantage of performance expectancy, effort expectancy, and convenience. In this way, developing a more appropriate m-payment that is flexible and manageable to match with the Sudanese users will be facilitated. Moreover, service providers should offer an excellent facilitating condition that enables users to the behavioural intention and actual use of m-payment. Third, the service provider should take gender, age, and education into account when developing an m-payment platform. Moreover, the operator should increase the public's impression and activate positive word of mouth (WOM) among users.

Finally, the result of this study found that infrastructure negatively affects the users' behavioural intention of using mobile payment. This indicates that although the users are not satisfied with the m-payment infrastructure, the users are still willing to use the service. Hence, operators should strive to enhance their service to be satisfactory to the users. Social and technological factors have played a key role in deciding the acceptance and usage of ICTs in various environments. Previous studies show that supporting infrastructure plays a vital role in making decisions about the technology to be used and sustainable usage in settings with limited ICT resources [80].

6. Limitations and Future Research

Similar to other studies, this paper has some limitations that provide opportunities for future research. The data of this research was collected from the online population. This may cause some pathways not to be relevant. Therefore, for research that includes internet access assessment, the offline mode of data collection will ensure a good mix of respondents from different strata. Paper questionnaires will reach individuals who are not digitally literate, and barriers to using IT, such as m-payments, will be more apparent to these respondents. Therefore, we highly recommend collecting data offline when it comes to accessing or knowledge of technology, especially in low-income countries, as the majority of the population will be excluded if the survey is distributed online. This research was conducted in Sudan, and the sample size was only 453; this does not provide a good opportunity for generalization.

Additionally, as the samples were gathered from the urban areas in Sudan; future research should collect data from the rural areas where the technology advancement, technology access,

education, and income are lower than in urban. Future studies can be conducted for different countries to examine whether the suggested model can be generalized. Future research can also consider users' culture and income as moderators in a theoretical model to explore different behaviour and concentrate on behavioural intention and actual usage of the m-payment context in Sudan. Moreover, future studies can examine the effects of other factors, such as accessibility, habit, enjoyment, etc., to enhance customers' behavioural intention to use m-payments in developing countries.

7. Conclusions

This paper has many contributions. One of our study's prominent contributions first is its ability to enable e-commerce to attract females customers since males dominate the Sudan market due to Sudanese Arab culture restriction. Moreover, mobile payment adoption allows the unbanked population to participate in financial transactions, which will help in economic development. Second, this study related to the developing countries' context of advanced information technologies. Third, we studied Sudan's potential in using mobile payment, which is not widely discussed in the literature before. This study's contribution for practioner is to enable under developed countries to select and deploy their mobile payment system. The academic is quite normal, using TAM or some other theory and integrating some factors from different perspectives.

This study examines the most critical factors that enhance users' behavioral intention for m-payments. To achieve the aim of this research, a model was proposed, in which several factors are identified (i.e., performance expectancy, effort expectancy, perceived convenience, social influence, government influence, technical culturation, infrastructure, economics issue and facilitating condition, gender age and education as a mediator, and actual usage). The result of multi-group analyses shows that the entire construct's significant effect upon behavioral intention and actual use, except for infrastructure, which has been found, negatively affects behavioral intention. Technical culturation and facilitating conditions have a more positive direct and indirect influence on behavioral intention and the mobile payment platform's actual usage. Moreover, the study shed light on gender differences to decrease the gender gap in Sudan. The result found out that gender differences remain; therefore, there is a need to increase females' awareness about the importance

of using mobile payment platforms and their benefit. It can enable the use of m-commerce. The awareness can be developed via education, a government program.

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